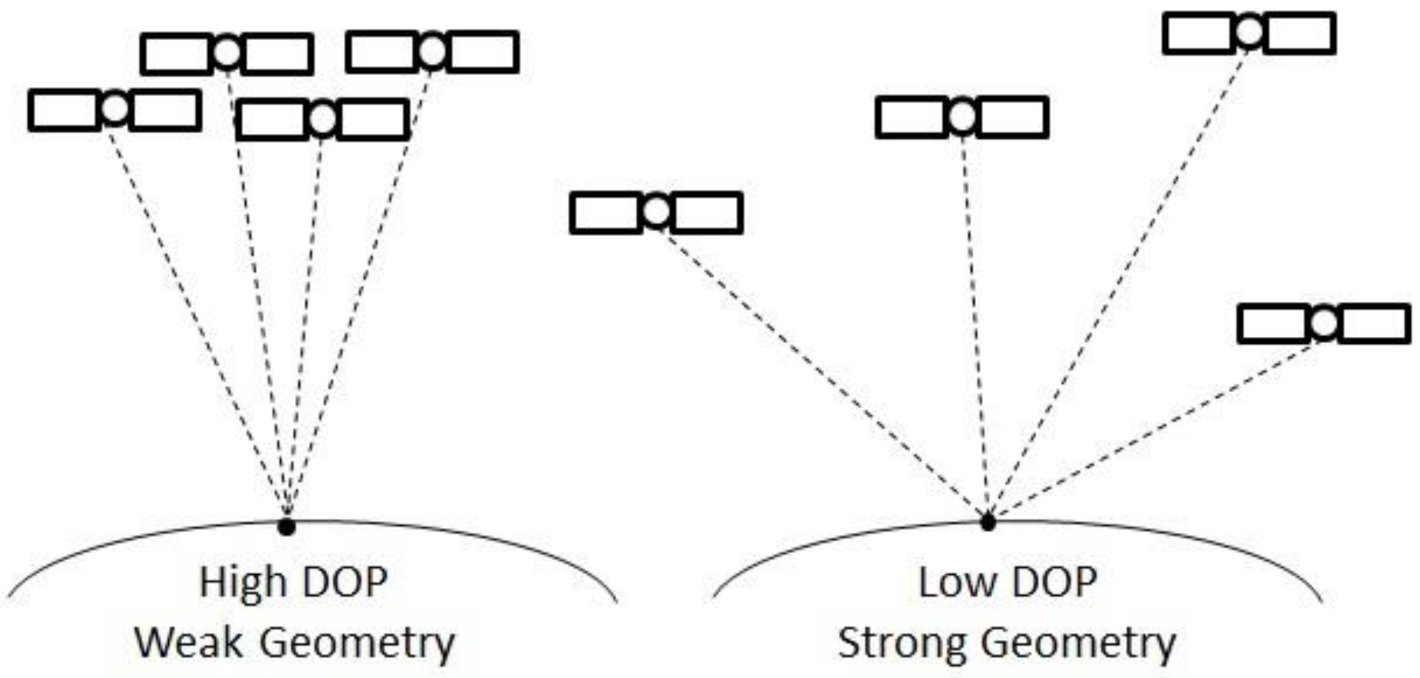
SÃO PAULO STATE UNIVERSITY CONTRIBUTION TO THE IGMA TRIAL PROJECT – PDOP AND BROADCAST EPHEMERIS ACCURACY ASSESSMENT

Abstract

In this presentation it is described the São Paulo State University – Unesp preliminary contribution to the International GNSS Monitoring and Assessment (IGMA) trial project. Unesp contributions are given in two approaches: The first one was towards the PDOP calculation and the development of a methodology to create the ".pdop" files. The second approach is related to the assessment of the quality of the broadcast navigation message from Galileo and GPS compared to the final International GNSS Service (IGS) ephemeris and between Unesp results and other analyzes center.

PDOP

PDOP (position dilution of precision) describes the contribution on the error caused by the relative position of the GNSS satellites. From the observer's point of view, if the satellites are spread apart in the sky, then the GNSS receiver has a good PDOP, however if the satellites are physically close together, then you have poor PDOP. This reduces the quality of your GNSS positioning.



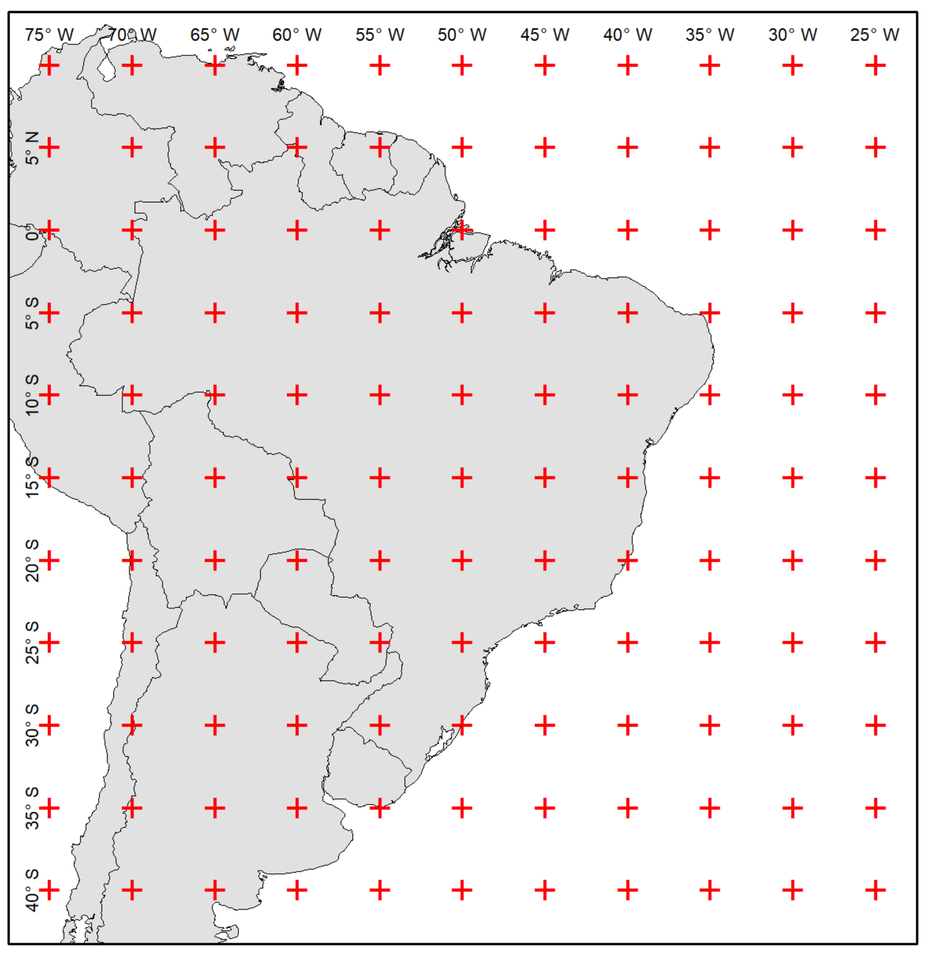
Ephemeris

Each GNSS satellite includes ephemeris data in the signal it transmits. This comprises a set of parameters that can be used to compute the position of a the satellite at a specific time, and hence describes the path the satellite is following as it orbits the Earth.

The ephemeris data are only valid for a limited period time (a few hours or less). Therefore, to up-to-date the ephemeris data is needed to minimize errors that result from the variations in a satellite's orbit.

Methodology

For PDOP a tool called UNESPDOP was created. Using broadcast message PDOP was calculated for GPS and Galileo, with a grid using the fixed angle method with 5-degree spacing and the following boundaries: Latitude 10 to -40-degrees; Longitude -30 to 80-degrees. The time sample was given in epochs of 5 minutes. For the broadcast ephemeris assessment, it was considered the initial test proposed by IGMA working group, assessing results of a common day (DOY 100 of 2018) with antenna offset to correct the difference between the center of mass (CoM) and the center of phase (CoP).



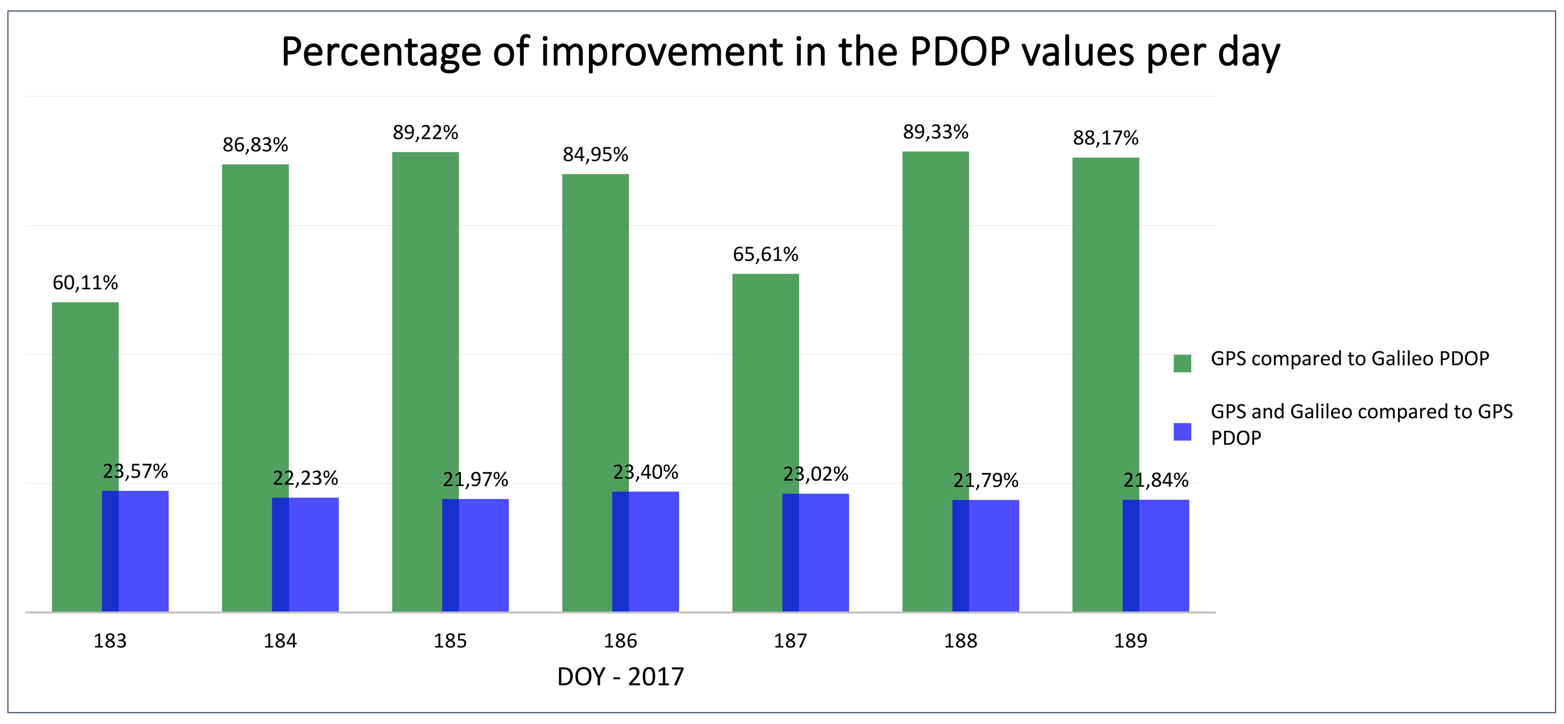
The workgroup provided the broadcast and final ephemeris files in order to hand-care the results comparisons from the different analyses centers. Unesp results were compared with those from the Research Institute of Geodesy, Topography and Cartography (RIGTC), Institut Cartogràfic i Geològic de Catalunya (ICGC) and Deutsches Zentrum für Luft- und Raumfahrt (DZL) and with the final ephemerides from IGS (international GNSS Service)

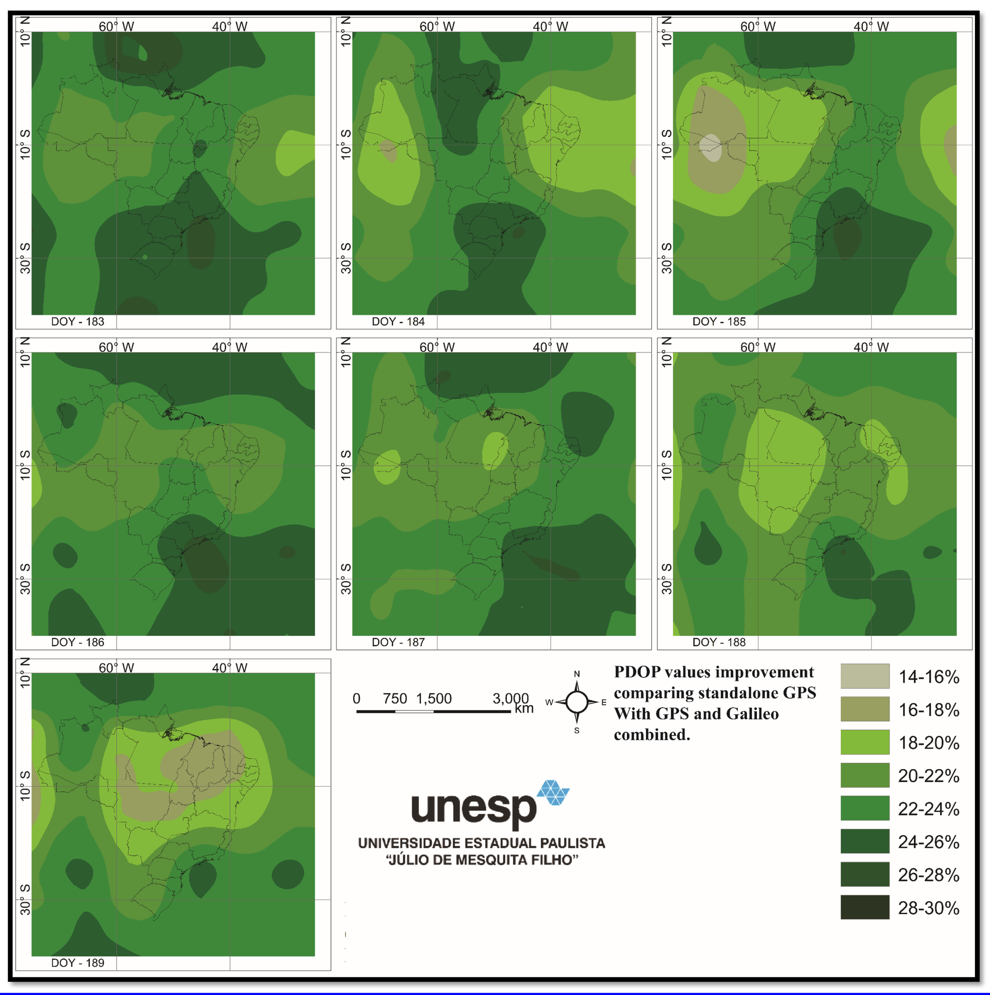
PDOP RESULTS

For the test week proposed by IGMA (week 1956) in the area presented in the methodology section the average PDOP for Galileo, GPS and the combination of them (GPS and Galileo) are:

System	Average	Standard Deviation	Average visible satellites
GPS	1.81	0.33	9.66
Galileo	12.13	79.63	5.34
GPS and Galileo	1.41	0.18	15.01

The average improvement from using Galileo only to GPS and Galileo is of the order of 80% for the week. For GPS in comparison to GPS and Galileo together the improvement is in the order of 22%.

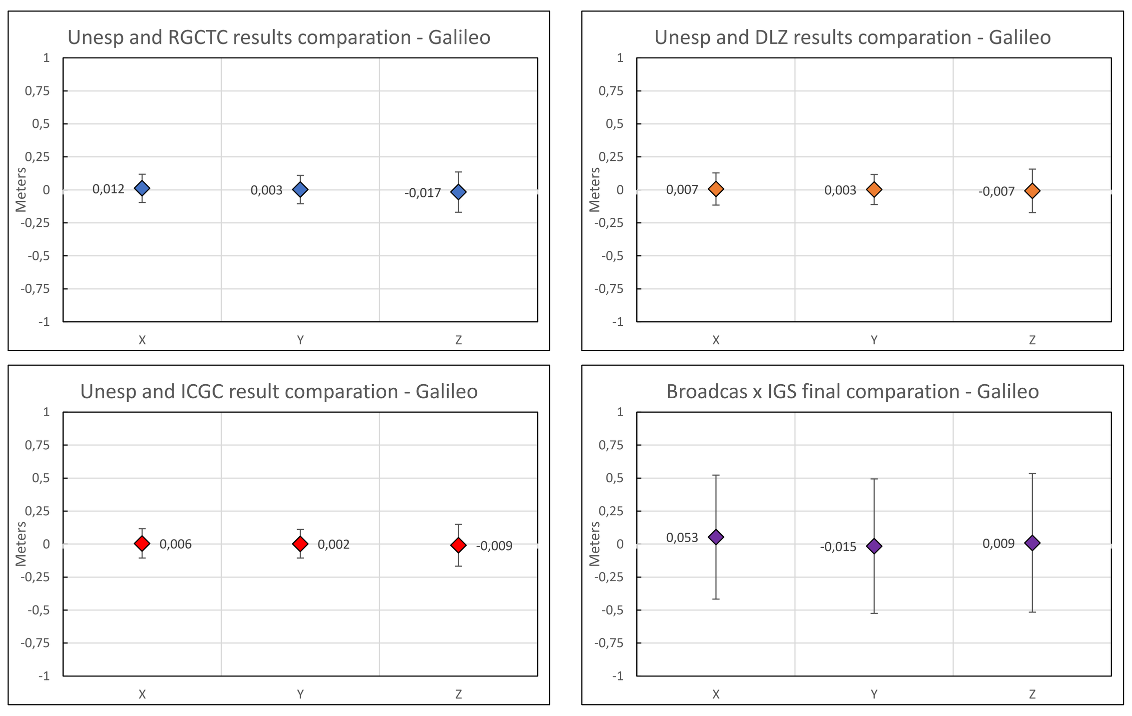


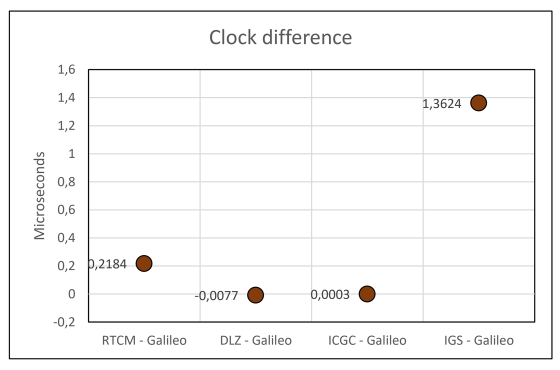


Ephemeris results

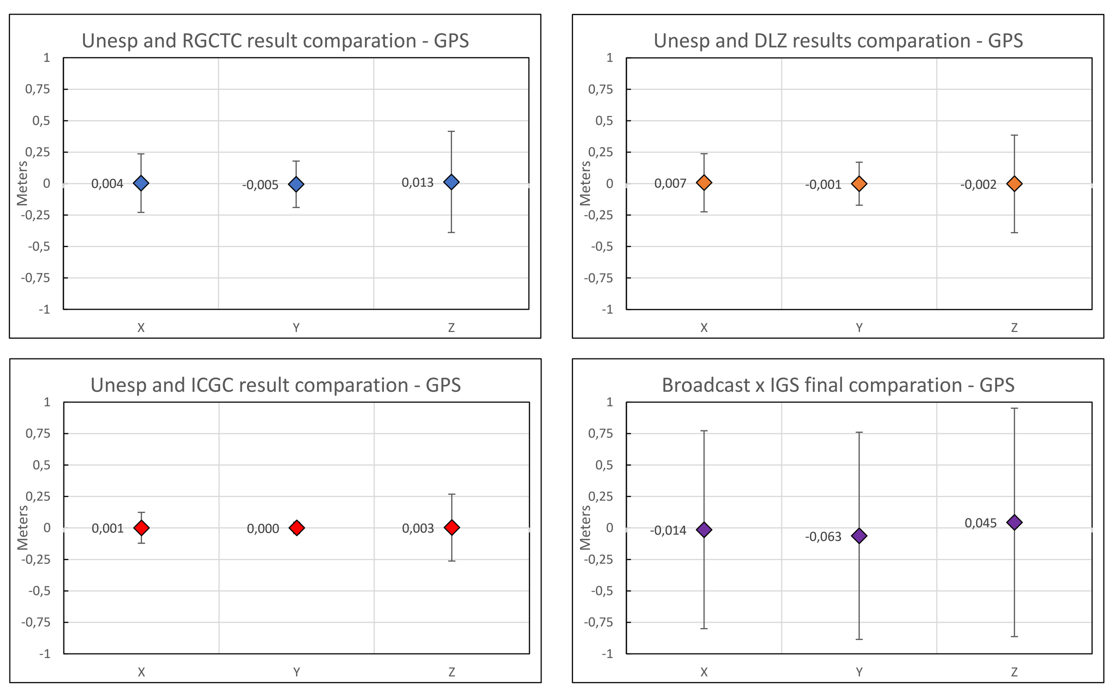
The mean difference for all satellites between each of the analysis centers and Unesp and between IGS final ephemeris and Unesp results obtained from broadcast messages are summarized in the graphics bellow.

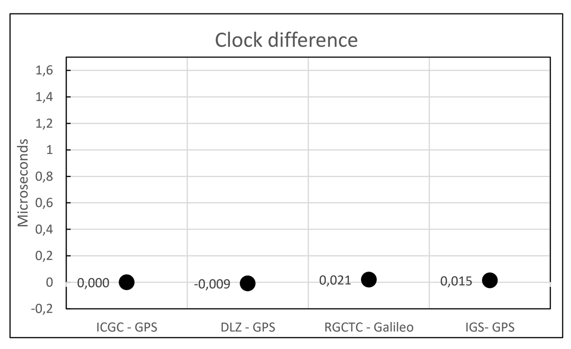
For Galileo:





and for GPS:





Discrepancies: IGS and broadcasted ephemerides

For computing the discrepancies, no corrections from CoM to CoP was carried out.

		Mean Discrepancies				Standard deviation			
System	Epoch	dx (m)	dy (m)	dz (m)	dclck (µsec)	dx (m)	dy (m)	dz (m)	dclck (µsec)
GAL	4148	0,053	-0,015	0,010	1362,410	0,500	0,510	0,544	2,154
GPS	8134	-0,014	-0,063	0,045	14,721	0,787	0,823	0,908	2,469

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